REMARKS/ARGUMENTS

Claims 1-4, 6-11, and 13-22 are pending. No amendment is made to any of these claims. Reconsideration of the present application in view of the following remarks is respectfully requested.

Claims 1-4, 6-11, 13-17, 21, and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over EP-0651041 ("EP '041") in view of Shorfheide et al. (US-6495029) ("Shorfheide"). Applicants respectfully transverse.

The present invention is directed to a process for carrying out gas-liquid countercurrent processing. The process comprises passing the liquid material and the gas reactant in countercurrent flow through the fixed bed of catalyst in a reactor. The fixed bed of catalyst includes two or more catalyst layers, with the difference of voidages between the adjacent catalyst layers being at least 0.05. *See*, e.g., claim 1.

First, a person of ordinary skill in the art would have not combined the teachings of the EP '041 and Shorfheide to arrive at the present invention, as suggested by the Examiner. There is no apparent reason for a person of ordinary skill in the art to do so. *See*,. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. _; 127 S. Ct. 1727; 82 USPQ2d 1385 (2007).

EP '041 discloses a fixed bed catalyst system of a hydrotreating catalyst comprising a physical mixture of high void catalyst particles and low void catalyst particles. The particles are mixed in different amounts in different layers of the catalyst bed so as to obtain within the fixed bed catalyst system a layered structure with different layers having different mixing ratios of the high and low void particles. *See* Abstract, page 2, lines 29-33 and 40-44, and claims 1 and 6. As explained at page 2, lines 4-15, "In many refineries, serious problems arise in hydrotreating reactors showing liquid maldistribution and pressure drop build-up due to plugging of the reactors by those solid contaminants". "By such a grading procedure, the deposits are allowed to penetrate deeper in the bed, and a higher contaminant uptake can, therefore, be attained before the catalyst bed is plugged off."

As the Examiner correctly recognized, EP '041 does not teach a gas-liquid countercurrent process. In fact, it is apparent from the context of EP '041, the method described therein is to solve the problem arising only from a gas-liquid co-current and downflow process, not a gas-liquid countercurrent process.

In a conventional gas-liquid co-current down flow process, the liquid (e.g., petroleum fraction) and gas (e.g.,, hydrogen) are introduced to the reactor at a point, or points, above one or more fixed beds of catalyst. The liquid and gas all flow in a downward direction through the catalysts bed(s). *See*, e.g., Shorfheid, col. 1, line 66 to col. 2, line 10 stating that gas-liquid co-current down flow process is a typical process of commercial use. In such a gas-liquid co-current down flow process, the contaminants contained the liquid and gas feedstocks start to deposit from the top of the catalyst layers, build-up pressure drop along the flow direction of the liquid and gas, and cause the discontinuance of operation prior to the expiration of the catalyst life. This problem is also described as "bed plugging" or "reactors plugging" in EP '041. As explained above, EP '041 provides a process which allows a deeper penetration of the contaminants and higher contaminant uptake before the catalyst bed is "plugged off."

On the other hand, in a liquid-gas countercurrent process, the liquid typically downflows from an upper position, and the gas upflows from a lower position through the catalyst bed. *See*, e.g., Shorfheide, col. 1, line 66 to col. 2, line 10 stating that gas-liquid counter-current process is presently of limited commercial use. The gas stirs upwards the liquid and solid catalyst bed so that the solid contaminants are not likely to "plug off" the catalyst bed and cause an excessive pressure drop along the flow direction of liquid feedstock prior to the expiration of catalyst life.

Therefore, the problem which EP '041 attempts to solve does not exist in a liquid-gas countercurrent process. A person of ordinary skill in the art would not have been motivated to apply EP '041's approach, specifically, void grading of the catalyst, to a liquid-gas countercurrent process, as described in Shorfheide. No is there any other apparent reason, which can be deduced from either EP '041 or Shorfheid by a person of ordinary skill in the art to substitute the co-current process of EP '041 for a countercurrent process as described in Shorfheid, as proposed by the Examiner.

In addition, at page 5, line 23, EP '041 discloses that a plug flow reactor is used in its process. It is well-known that in a plug flow reactor, no back mixing is assumed with "plugs" of fluid passing through the reactor. *See* http://en.wikipedia.org/wiki/Plug_flow (last accessed October 30, 2007). While a reactor for liquid-gas co-current down flow process may be construed as a plug flow reactor, a reactor for liquid-gas countercurrent process cannot. In a reactor for liquid-gas countercurrent process, during a hydrocarbon hydrotreating reaction process, partial vaporization of those resultant small molecules and raw materials under reaction conditions increases the gas-liquid volume ratio at the upper section of reactor (*see* paragraph [0018] of the present application), and the back mixing of stream occurs. This further indicates the process described in EP '041 is only a gas-liquid co-current and downflow hydrotreating process, not a gas-liquid countercurrent hydrotreating process.

Second, even if a person of ordinary skill in the art were to substitute the co-current process of EP '041 for a countercurrent process as described in Shorfheide, as proposed by the Examiner, this person would not have arrived at the present invention.

As the Examiner correctly recognizes, EP '041 fails to specifically discloses that the difference of vodiages between the adjacent layers is at least 0.05 as recited in the claims of the present application. In fact, EP '041 teaches away from using adjacent layers, with the difference of their vodiages being at least 0.05.

Specifically, in EP '041, the ratios of high void catalyst and low void catalyst in different layers are different and decrease along the flow direction of liquid phase. The purpose of do so is to increase the capacity of contaminant storage and prevent "plugging of catalyst bed" by contaminants. *See*, for example, page 2, lines 6-28. This is further illustrated by the Examples and Comparison Examples.

For example, in pages 5-6, Comparison Example B, double layers are graded in a reactor, with the upper layer being 100% of particles in the form of ring (the voidage is 0.560, *see* page 4, Table 1), and the lower layer being 100% of particles in the form of threelobe (the voidage is 0.442, *see* page 4, Table 1). The difference of the voidages of the two layers is 0.118. As shown in Figure 4, the amount of the solid deposited on top of the lower layer is very large, which will likely cause plugging at such a position of the reactor, as explained at page 2, lines 4-22 and page 5, line 51 to page 6, line 5. This Comparison Example B shows that the problem of "reactor plugging" cannot be solved if the difference of voidage between adjacent catalyst layers is significant.

Therefore, to avoid the problem of a large amount of solid contaminants deposited on top of the lower layer in Comparison Example B, EP '041 proposes the use of void catalyst grading, which allows both a smooth change from high void material (rings) to low void material (threelobes) and provides a smooth change in filtering effect. For example, the catalyst layers provided in Example 2 are as follows: the top layer with 100% ring (the voidage is 0.560, obtained from Table 1); the subsequent layers with a mixture of 85% of ring and 15% of threelobe (the voidage is about 0.530, obtained from Figure 1) and 48% of ring and 52% of threelobe (the voidage is about 0.480, obtained from Figure 1); and at bottom a layer with 100% of threelobe (the voidage is 0.442, obtained from Table 1). The difference of voidage between adjacent layers is no greater than 0.050. It can be seen from Figure 5 that the larger the difference in the voidages of adjacent layers is, the larger the amount of the solid deposited on top of the lower layer is.

These teachings show that to increase the capacity for contaminant storage and prevent reactor plugging, the voidage of the upstream catalyst bed must be larger than that of the downstream catalyst bed; and the voidage difference between the two adjacent catalyst layers shall be as small as possible.

Therefore, even if a person of ordinary skill in the art were to substitute the co-current process of EP '041 for a countercurrent process as described in Shorfheide, as proposed by the Examiner, this person would only use catalyst layers, with the difference of voidage of the adjacent layers being as small as possible, not at least 0.05 as recited in the claims of the present application.

Based on the foregoing, claims 1-4, 6-11, 13-17, 21, and 22 are all patentable over EP '041 and Shorfheide.

Applicants believe that the present application is in condition of allowance. Early and favorable consideration is respectfully solicited.

It is believed that no fees or charges are required at this time in connection with the present application. However, if any fees or charges are required at this time, they may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

Respectfully submitted,
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